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Educating Scientists with Plymouth University

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A science degree must teach students to be scientists. Many students will obtain a science degree and use their newly gained transferable skills to work in non-science avenues but, at the core of every science degree, should be the educating of students to be scientists. Essentially, a science degree should train students to ask and answer questions within their chosen field. You would expect a qualified doctor to have practised medicine during their university education, and likewise, you would expect scientists to practise science. By studying marine biology at Plymouth University I feel I received the very best research education. The marine biology degree programmes deliver essential knowledge, like all traditional degrees, but what makes them stand out is their research-led, question-driven teaching and learning approach. Not only do they provide this essential education as part of the curriculum, marine biologists studying at Plymouth University also benefit from a rich academic environment in which they can feel like a contributing part of the research community.

The question is... *How do we teach students to become scientists?*

Here I will outline three case studies of my experience as an undergraduate at Plymouth University. Each case study aims to highlight exactly how the Marine Biology and Ecology Research Centre (MBERC) facilitate the scientific schooling of undergraduate students. These are just three of a number of experiences which are crucially important in the Plymouth University marine biology research education. Unfortunately I've had to miss out incredibly significant experiences such as field courses, practicals and funding role-play events - there are simply too many case studies to choose from.

1. Research-led teaching in a stimulating intellectual environment: third year marine microbiology module.

The third year marine microbiology module builds on core themes of microbiology using research knowledge to inform teaching. An example of a typical order of events:

- Learn about a topic during lectures, for example, the correlation between marine vibrio pathogens and rising sea surface temperatures. Lectures included the core concepts as well as recent research findings.

- A week later, by coincidence, the opportunity arises to attend a seminar at the Marine Biology Association (MBA) given by one of the leading scientists in the field of marine human pathogens and climate change. This provided students with snapshots of the very latest unpublished data, as well as participating in a stimulating discussion about the work with other scientists at the MBA.
- Blog and discuss the research with other students through a Google-powered blogging website as part of an on-going coursework assignment.

The research-led approach used in the marine microbiology module is mirrored across the degree programme. Plymouth students benefit from a captivating intellectual environment that provides an engaging link to the wider research community.

2. Research-based learning: the honours project, in all its forms and glory.

Marine biologists interact with the honours project, indirectly, in every year of study via the honours project conference. In this conference third years present the findings of their research over a series of parallel sessions in full-sized lecture theatres. All staff and students involved in the marine biology degrees attend. It was this conference which sparked my interest in research and the following events entailed:

- As a first year I attended the conference and was particularly captivated by a third year explaining her research on microplastic pollution.
- With my interest sparked during the first year, I enquired with lecturers about the possibility of getting involved in microplastic research projects.
- In the second year I volunteered on a microplastic project, analysing samples from the Chagos Archipelago. I analysed the data and the write-up was included in a large collaborative publication.
- In the third year I carried out my own honours research project on the potential biological effects of microplastic pollution. I have since presented the findings at national and international conferences and I am in the process of converting my honours project into a manuscript for publication.
- In the third year I also volunteered on a separate microplastic project, after analysing the data I was involved in writing a collaborative paper which has recently been published in The Royal Society's new journal – Royal Society Open Science.

For me, the honours project - in all its forms and glory - represented the pinnacle of my education. I was practising science, within a supportive research community. Through idea development, to resource acquisition, collaborative environments,

experimental design, data gathering and analysis to presenting results in various formats (papers, oral presentations, posters, academic discussion with co-authors and everything in-between). The only way to learn to do science... Is to do science.

3. Support into post-graduate positions

Moving into the third and final year of study, students typically begin to get twitchy about what life has to offer after a bachelor's degree. For those students who have decided research is what makes them tick, Plymouth University is an extremely supportive environment for making the transition from undergraduate studies to post-graduate research. I personally had two avenues lined up; a Masters programme in Germany and a PhD in the UK had both caught my attention. After firing off emails to the appropriate members of staff, I was quickly invited for informal chats and advice sessions on how to boost my application's impact. In addition, I was pointed in the right direction of useful seminars and networking opportunities where I could get some insights into the fields I was applying for. All the staff were incredibly supportive, finding time to write references and give me interview tips. On top of everything, the positive energy and "go for it" attitude was what really made me feel I was ready to apply to post-graduate research.

So if you're reading this as a marine biology Plymouth University undergraduate – great news! You're exactly where you need to be if you want to learn how to be a scientist. If you're an undergraduate from elsewhere and you're interested in being a scientist then my advice to you is to surround yourself with research; seminars, journal clubs, blogs, volunteering, and most importantly – get involved with doing some science! If you're reading this and want to educate your students to be scientists then my advice to you is to let them into your research community. Let them do science, all the time, as much as possible.